THEORY OF COMPUTATION-1: (GATE 2022) - REPORTS

Q. 1

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Consider the following regular grammar. E_1 is the starting of the grammar.

$E_1 = bE_2$
$E_2 = aE_1 + bE_3$
$E_3 = \epsilon + bE_1$

Which of the following is the correct regular expression for the above?

A $b(ab + bbb)^*$

B $b(ab + bbb)^*\ b$ — Your answer is **Correct**

Solution :
(b)

We get $\quad E_1 = bE_2,\quad E_3 = \epsilon + bbE_2$ and then

$\quad E_2 = (ab + bbb)E_2 + b$

Arden's Lemma: A solution of $x = Rx + S$ is $x = R^*S$

and hence $\quad E_2 = (ab + bbb)^*b$ and $E_1 = b(ab + bbb)^*\ b$

C $b(a + b)^*\ b$

D $b(ab)^*$

QUESTION ANALYTICS +

Q. 2

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Which of the following regular expression corresponds to the language of all strings over $\Sigma = \{a, b\}$ that does not end with ab?

A (a + b)* (aa + ba + bb) — Your answer is **IN-CORRECT**

B bb* ab* ab* a

C b* aa b*

D None of these — Correct Option

Solution :
(d)
Regular expression for the language that does not end with ab is
$(a + b)^*\ (aa + ba + bb) + a + b + \epsilon$
Option (a) can not generate ϵ, a, b.
Hence it is not correct regular expression.

QUESTION ANALYTICS +

Q. 3

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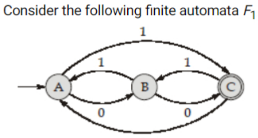
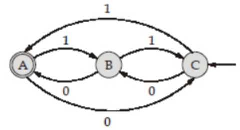
Consider the following finite automata F_1 that accepts the language L.



Let F_2 be a finite automata which is obtained by the reversal of F_1. Which of the following is correct?

A $L(F_1) = L(F_2)$ — Correct Option

Solution :
(a)
The finite automata obtained by F_1 is



Automata F_2 is same as F_1. So $L(F_1) = L(F_2)$.

B $L(F_1) \neq L(F_2)$ Your answer is IN-CORRECT

C $L(F_1)$ = complement of $L(F_2)$

D $L(F_2) \subseteq L(F_1)$

QUESTION ANALYTICS +

Q. 4 Solution Video Have any Doubt ?

Consider a language L = {ab, ba, abab} represented in the form of DFA machine. Which of the following strings present in the function INIT(L)?

A bab

B aba Your answer is Correct

Solution :
(b)
INIT(L) is a function which contain all the prefix strings of the language 1.
So, INIT(L) = {∈, a, b, ab, ba, aba, abab}

C aab

D baab

QUESTION ANALYTICS +

Q. 5 FAQ Solution Video Have any Doubt ?

The pumping lemma says that every regular language has a pumping length p, such that every string in the language can be pumped if it has length p or more. If p is a pumping length for language A, so is any length $p' \geq p$. The minimum pumping length for A is the smallest p that is a pumping length for A.
What will be the minimum pumping length for the regular expression $0^* 1^+ 0^+ 1^* \cup 1\ 0^*\ 1$?

A 1

B 2

C 3 Your answer is Correct

Solution :
(c)
The minimum pumping length is 3. The pumping length cannot be 2 because the string 11 is in the language and it cannot be pumped. Let s be a string in the language of length at least 3. If s is generated by $0^* 1^+ 0^+ 1^*$, we can write it as xyz, where x is the empty string, y is the first symbol of s and z is the remainder of s. Breaking s up in this way shows that it can be pumped. If s is generated by $10^* 1$, we can write it as xyz, where $x = 1$ and $y = 0$ and z is the remainder of s. This division gives a way to pump s.

D 4

QUESTION ANALYTICS +

Q. 6 FAQ Solution Video Have any Doubt ?

Consider the following two statements:
$S_1 : \{0^{3n} \mid n \geq 1\}$ is a regular language.
$S_2 : \{0^x\ 0^y\ 0^{(x+y)} \mid \geq 1 \text{ and } y \geq 1\}$ is CFL but not regular language.
The number of above correct statements is/are ______.

1 Your answer is Correct1

Solution :
1

- S_1 is correct and S_2 is incorrect.
- S_1 can be written as $(000)^n$ where $n \geq 1$. Regular grammar for S_1 is $S \rightarrow S000/000$. Hence S_1 is regular.
- S_2 can be written as $(00)^{(x+y)}$ where $x \geq 1$ and $n \geq 1$. S_2 can be further reduced to $(00)^x$ where $x \geq 2$. Regular grammar for S_2 is $S \rightarrow S00/0000$. Hence S_2 is also regular language.

QUESTION ANALYTICS +

Q. 7

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Consider the following languages:

$L_1 = \{0^i 1^j 2^k \mid i \mathrel{!}= j \text{ and } k > 0\}$
$L_2 = \{0^i 1^j \mid i = j\}$
$L_3 = \{0^i 1^j 2^k \mid k = 2j + 1 \text{ and } i >= 200\}$
$L_4 = \{0^i 1^j 2^k \mid i <= 200 \text{ and } j <= 200 \text{ and } k <= 200\}$

How many of the above language is CFL but not regular?

3 — Correct Option

Solution :
3

- L_1 is CFL but not regular as there is infinite comparison between 0 and 1. It is CFL because only 1 comparison and k is not comparing with others, it is simply greater than 0 which can be done by DCFL as well.
- L_2 is DCFL but not regular.
- L_3 DCFL but not regular same concept as explained for L_1.
- L_4 is regular since the given comparisons is finite number. Hence we can make finite automata for the given L_4.
  Hence all four are CFL. Since it is asking CFL but not regular so 3 is the correct answer.

Your Answer is 2

QUESTION ANALYTICS +

Q. 8

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Let $L = \{\epsilon, 0, 01, 10\}$. Which of the following strings belongs to L^5?

A. 11001001010

B. 101001001 — Your option is Correct

C. 1001000 — Your option is Correct

D. 01101001 — Your option is Correct

YOUR ANSWER - b,c,d | CORRECT ANSWER - b,c,d | STATUS -

Solution :
(b, c, d)
For strings belong to L^5, there should be combination to exactly 5 strings.
Here L contains ϵ, the strings in L^5 should be a combination of atmost 5 non null strings which belong to L as the remaining component could be the null string.
(a) 11001001010 does not belong to L^5 as initial 11 can not be generated by any combination.
(b) 101001001 can be generated using combination 101001001.
(c) 10010000 can be generated using 1001000.
(d) 01101001 can be generated using 011001001.

QUESTION ANALYTICS +

Q. 9

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Which of the following RE is equivalent to the given grammar? Here start variable is X.

X = aX + bY
Y = ∈ + cY + dX

A. a*b(c + da* b)* — Your option is Correct

B (a + bc*d)*bc* Your option is Correct

C (a + c*d)*bc*

D Regular expression is not possible as the given grammar is not regular grammar

YOUR ANSWER - a,b | CORRECT ANSWER - a,b | STATUS -

Solution :

(a, b)

$$X = aX + bY$$
$$Y = \epsilon + cY + dX$$

If we eliminate X first then we get X = a*b(c + da* b)*

If we eliminate Y first we get X = (a + bc*d)*bc*

$$a^*b(c + da^* b)^* = (a + bc^*d)^*bc^*$$

Hence both (a) and (b) is equivalent RE for the given regular grammar.

QUESTION ANALYTICS +

Q. 10 ? FAQ Solution Video Have any Doubt ?

What will be the CFG for the language $L = \{w\#x : w^R \text{ is a substring of } x \text{ for } w, x \in \{0, 1\}^*\}$.

A
$S \rightarrow T\#X$
$T \rightarrow 0T \mid 1T \mid \#X$
$X \rightarrow 0X \mid 1X \mid \epsilon$

B
$S \rightarrow T \mid X$
$T \rightarrow 0T0 \mid 1T1 \mid \#X$
$X \rightarrow 0X \mid 1X \mid \epsilon$

C Your answer is Correct
$S \rightarrow TX$
$T \rightarrow 0T0 \mid 1T1 \mid \#X$
$X \rightarrow 0X \mid 1X \mid \epsilon$

Solution :

(c)

L can be written as $\{w \# (0 + 1)^* w^R (0 + 1)^*\}$

The context-free grammar that generate L is

$S \rightarrow TX$
$T \rightarrow 0T0 \mid 1T1 \mid \#X$
$X \rightarrow 0X \mid 1X \mid \epsilon$

D None of these

QUESTION ANALYTICS +